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Metals, Ceramics, and Materials

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A VIBRATORY POLISHER FOR REMOTE METALLOGRAPHY

by

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and

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METALS, CERAMICS, AND MATERIALS
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A VIBRATORY POLISHER FOR REMOTE METALLOGRAPHY

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August 1962

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Explosives Department - Atomic Energy Division
Technical Division - Savannah River Laboratory
Aiken, South Carolina

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Approved by
D. E. Waters, Research Manager
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ABSTRACT

A vibratory polishing machine that is commercially available was adapted to polish irradiated metallographic specimens in a hot cell. The modified polisher is easy to operate and maintain remotely, and provides for both chemical attack and abrasive polishing.

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A VIBRATORY POLISHER FOR REMOTE METALLOGRAPHY

INTRODUCTION

A polishing machine capable of producing a flat, smooth metal surface is required to prepare metallographic specimens for examination. Vibratory lap-polishing machines provide a simple means for obtaining polishes of high quality easily and automatically on many specimens. The simplicity of these polishers makes them ideal for adaptation to hot cell work where all operations and maintenance must be done remotely with master-slave manipulators or other specially designed equipment.

Standard vibratory polishing machines are available commercially*. These commercial polishers were developed for general industrial use where direct operation and maintenance can be accomplished. Direct access to the polishers is not feasible when they are used in a hot cell. This report describes the modifications made to these commercial machines to facilitate their operation and maintenance with remote manipulators.

SUMMARY

A vibratory polishing machine, suitable for remote use in a hot cell, was developed by modifying a commercial polisher with parts designed to facilitate remote operation and maintenance. The modified polisher will produce an excellent finish in less than two hours with either the chemical attack or the abrasive polishing technique.

Three working models have been in use in a high level cell since December 1960.

DISCUSSION

The modified vibratory polishing machine consists of a bowl, a power unit, and an electrical power supply (Figures 1 and 2). The bowl holds the metallographic specimens, the polishing cloth, and the abrasive or chemical. The bowl is clamped to an adapter plate that is attached to the power unit. The power unit consists of a heavy base, an electromagnet, and four sets of inclined leaf springs. The springs support the magnet armature and the adapter plate. The power supply provides half-wave rectified current to actuate the electromagnet.

The springs in the power unit are flexed approximately 60 times each second by the electromagnet. The bowl moves vertically and rotates back and forth a few thousandths of an inch during each spring flexure. As the bowl moves, the metallographic specimens slip over the abrasive-laden cloth mounted in the bowl. The slipping action polishes the specimen surface.

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* Sources of supply - Syntron Company, Homer City, Pa.; and Fisher Scientific Co., Pittsburgh, Pa.

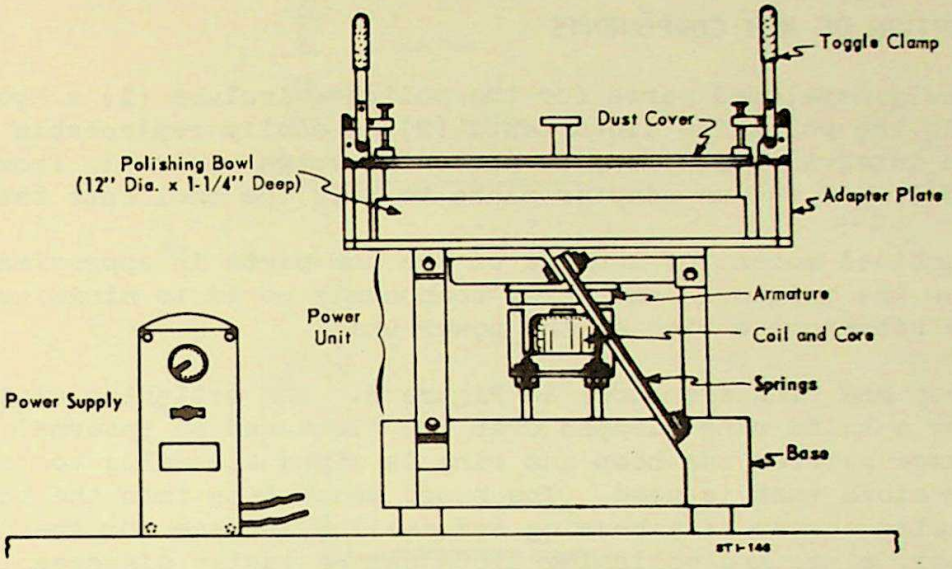

FIG. 1 BASIC PARTS OF MODIFIED VIBRATORY POLISHER

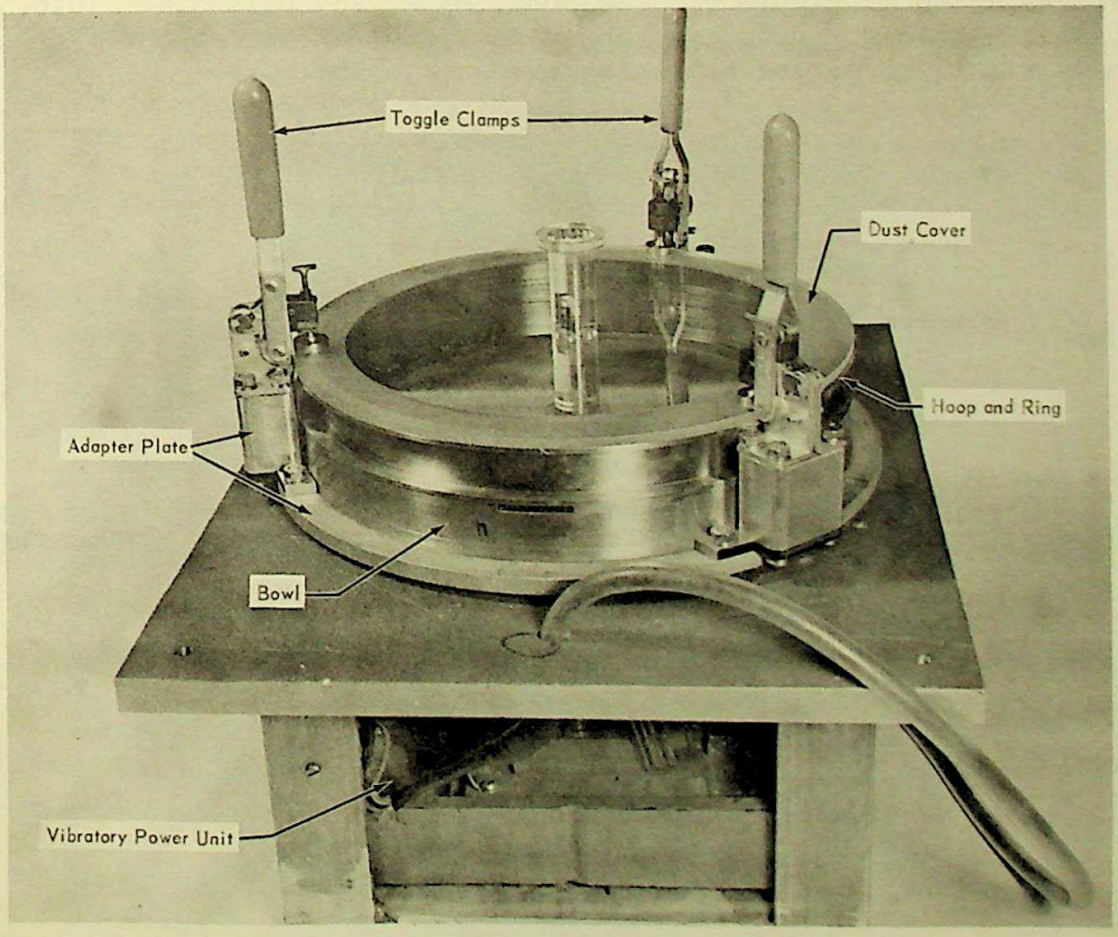

FIG. 2 VIBRATORY POLISHER ASSEMBLY

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DESCRIPTION OF NEW COMPONENTS

The newly developed parts for the polisher include (1) a hoop and ring to hold the polishing cloth taut, (2) an easily replaceable bowl, (3) an integral dust cover to prevent foreign materials from entering the bowl, and (4) an adapter plate to hold the bowl onto the power unit.

The combined moment of inertia of the new parts is approximately the same as the original commercial components so as to minimize any effect on the vibratory action of the power unit.

The hoop and ring are shown in Figure 3. The polishing cloth is held taut by a solid ring slipped over the cloth and an internal hoop. The clearance between the hoop and ring is sized according to the thickness of the cloth that is used. The hoop, which fits into the polishing bowl, also serves as a bearing and sealing surface for the dust cover. The hoop, ring, and polishing cloth can be easily disassembled remotely with the tool shown in Figure 4.

The bowl is cylindrical with a flat bottom. A groove is cut inside the bowl as shown in Figure 5. The hoop, ring, and polishing cloth assembly fits down into the groove as shown in Figure 6 so that the cloth is drawn tightly over the polishing surface in the bowl.

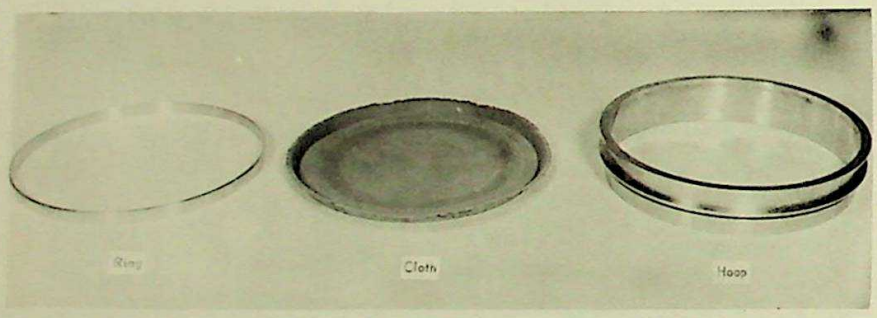

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FIG. 3 RING, POLISHING CLOTH, AND HOOP

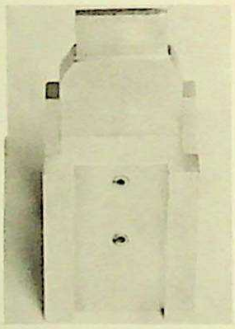

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FIG. 4 HOOP AND RING DISASSEMBLY TOOL

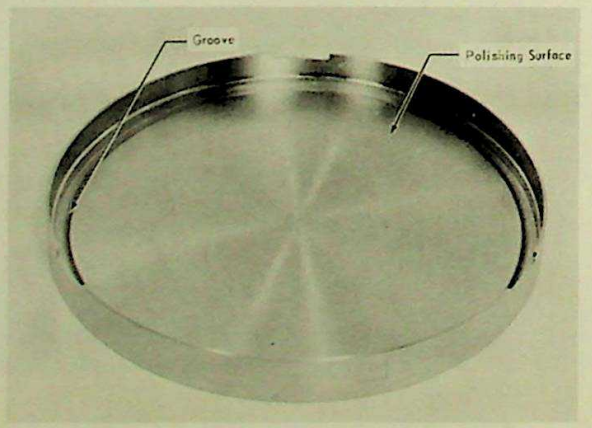

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FIG. 5 POLISHING BOWL

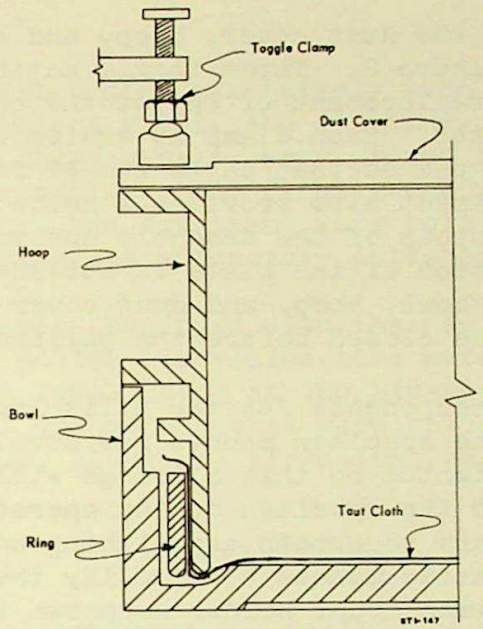

FIG. 6 CROSS-SECTIONAL VIEW OF BOWL ASSEMBLY

The dust cover as shown in Figure 7 is a flat transparent disc that sits on the hoop. The cover can be handled easily with the manipulator knob located in the center. The periphery of the disc is machined to a constant thickness so that the orientation of the cover is not critical. During the polishing operation, the specimens can be observed through the transparent cover.

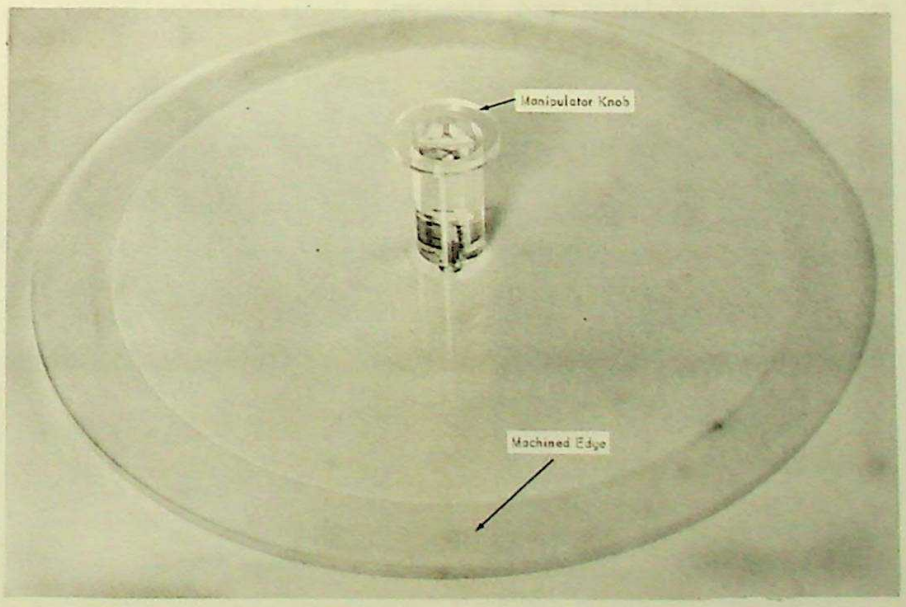

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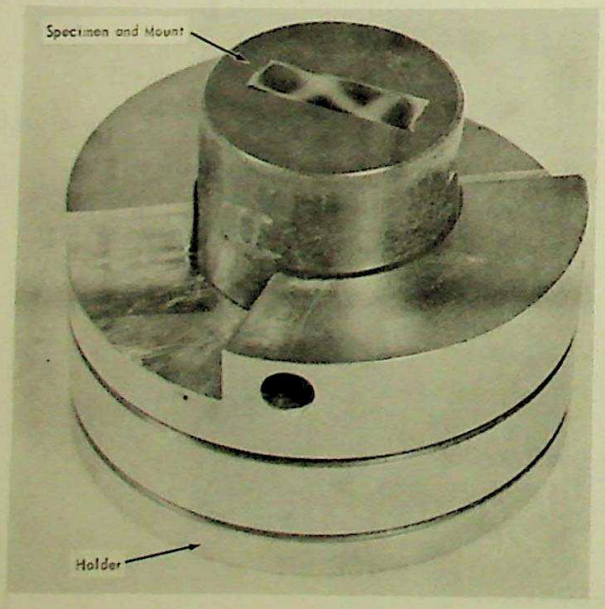
FIG. 7 DUST COVER

The adapter plate holds the dust cover, hoop, and bowl to the vibratory power unit as seen in Figure 2. Three toggle action clamps mounted on the plate permit quick replacement of any of the components easily with a master-slave manipulator. Each clamp is equipped with an adjustment thumbscrew and pressure pad so that parts can be interchanged between polishers. This arrangement also provides a means of compensating for any change in the dimensions of the assembly due to vibration and clamping loads. The bottom of the plate is attached to the armature of the electromagnet. The bowl, hoop, and dust cover must be in place and the toggle clamps must be closed before the polisher will operate.

In addition to the new components for the polishing machine, a simple holder and weight for the specimen mounts was developed. A specimen must be sufficiently weighted so that slippage will occur between the abrasive-laden cloth and the specimen during operation of the polisher. This slippage is necessary to obtain a polishing action. Specimens are normally molded into plastic mounts to simplify the handling of small metal pieces. The specimen mount holder as shown in Figure 8 was developed for the normal plastic mount. It ensures a weight of 750 grams on the polishing surface, which is optimum for the particular type polisher, polishing cloth, grinding compound, and vehicle used during this development work. The weight should be adjusted when any of these variables are changed.

The holder has a simple shape with a minimum of internal and hidden holes. The polishing abrasives can be easily removed from the holders, which reduces the possibility of cross-contaminating polishing grits when a specimen is moved from polisher to polisher. Four ball plungers grip the specimen mount. The ball plungers permit easy insertion of the mount into and removal from the holder.



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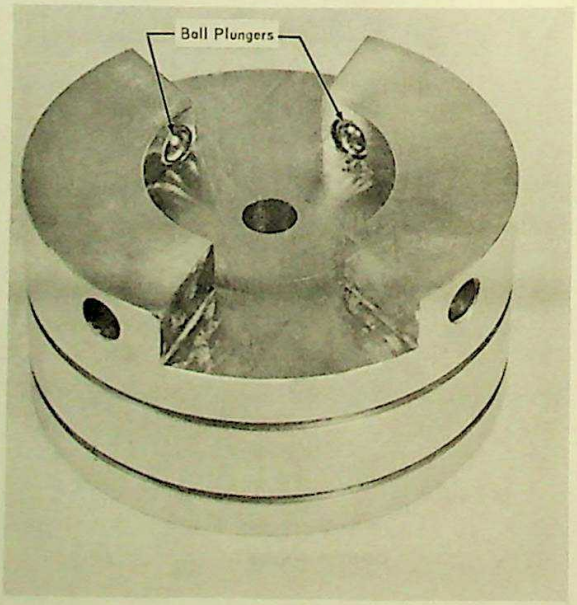

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FIG. 8 SPECIMEN MOUNT HOLDER

OPERATING EXPERIENCE

The new components were tested extensively with unirradiated materials such as uranium, stainless steel, and aluminum. The test specimens, which were made from these metals, were ground in the normal manner either by hand or by machine. The final grind was made using 600 grit paper. After grinding, the specimens were polished in the modified polisher. Each specimen was adequately polished in less than two hours.

Three vibratory polishers equipped with the new components have been used successfully to polish the radioactive metallographic specimens processed in the High Level Caves at the Savannah River Laboratory since December 1960. The metals that were polished included irradiated uranium, uranium oxide, aluminum, zirconium, carbon steel, and stainless steel.

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